

Permit Writer's Review Notes  
Worksheets, Etc.

EPU 8-D  
44000023

MT2023-0023



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION VIII  
ONE DENVER PLACE — 999 18TH STREET — SUITE 1300  
DENVER, COLORADO 80202-2413

PUBLIC NOTICE

INTENT TO ISSUE AN UNDERGROUND INJECTION CONTROL  
PERMIT TO OPERATE A CLASS II INJECTION WELL

PURPOSE OF PUBLIC NOTICE

The purpose of this notice is to solicit public comment on the proposal by the Region VIII Office of the U. S. Environmental Protection Agency (EPA) to issue a permit to inject fluids underground via a Class II salt water disposal injection well.

BACKGROUND

EPA Region VIII is currently reviewing an application for an Underground Injection Control (UIC) Permit from Murphy Oil USA, Inc., 200 Peach Street, El Dorado, Arkansas 71730, regarding injection of water for the purpose of salt water disposal. The proposed injection fluid is produced from the Mississippian Formations known as Madison "A", "B", and "C" Formations. Murphy Oil USA, Inc. requested to inject fluids into the Judith River Formation through an injection well located 1980 feet from the South line and 1980 feet from the East line of Section 10, Township 28 North, Range 51 East in Roosevelt County, Montana. The well's common name is EPU 8-D.

EPU 8-D is found on an EPA aquifer exemption listing referred to in 40 CFR 147.1352. At the time that 147.1352 became effective on June 25, 1984, a portion of the Judith River Formation, as defined by a one-quarter mile radius, was exempted for the purpose of oil and gas injection activities. This action is consistent with the intent of the UIC program because, historically, the well has been injecting fluids whose total dissolved solids content is approximately 130,000 parts per million (ppm). Since that time, the original quality of the Judith River Formation at this location has been determined to be in excess of 10,000 mg/l TDS. This means that the initial exemption is superfluous, because an aquifer is only exempted when its quality of total dissolved solids is less than 10,000 mg/l.

EPA has made a preliminary determination to approve the permit application and that by doing so, all underground sources of drinking water will be protected. Therefore, EPA is hereby serving notice of intent to issue a permit for the proposed underground injection activities to Murphy Oil USA, Inc. This action is being taken as provided by Part C of the Safe Drinking Water Act and attendant regulations, 40 CFR 144.33 and 146.4.

average Max Req = 650  
Average monthly BBL = 180,347.5; average daily 6011.58

range 207,314  $\rightarrow$  147,726  
6910.5  $\rightarrow$  4924 BBL

Table 1. Well Construction and P&A Plan for EPU 8-D.

	Hole (inch)	Casing Size (inch)	Set at (feet)	Perforated Zone (feet)	Sacks of Cement
<b>Well Construction</b>					
Conductor Pipe	17 1/4	13 3/8	100		200
Surface Casing	12 1/4	9 5/8	960		3904
Production Casing	8 3/4	5 1/2 CIBP	5,765 1,000	830 - 880 990 - 991 700	9.50 350
Tubing		2 7/8	737	Packer at 732	100
<b>P&amp;A Plan</b>					
Plug 1		7	3,583		
Plug 2		7, 9 5/8	700		
Plug 3		7, 9 5/8	90		

Block  
 830 - 880  
 990 - 991  
 700  
 Packer at 732  
 Surface

780 105x  
 694  
 100 105x  
 14

5650  
 5200

No data  
 on 603



INJECTION FLUID LIMITATION

(Condition 6)

The only fluids to be injected through this well are produced fluids from the Mississippian Madison formation. The TDS of the injection fluid ranges from 27,000 to 225,000 mg/l. The composite TDS of the injection fluid is approximately 130,000 mg/l. The ambient water quality of the Judith River formation is approximately 100,000 mg/l.

PART II, Section E

PLUGGING AND ABANDONMENT

PLUGGING AND ABANDONMENT

The P&A plan submitted by the applicant with the permit application is incorporated into the permit with changes. The cement in Plug 1 shall be placed across the injection perforations with the bottom of the plug located at 3,583 feet or total depth of well whichever is deeper. The top of the plug is located at 3,070 feet. Plug 2 shall be placed at 700 feet with half the cement inside the 7" casing and half in the 9 5/8 casing/7" casing annulus. The top of the plug remains at 620 feet, as originally designed. Plug 3 shall be placed at 90 feet with half the cement inside the 7" casing and half in the 9 5/8 casing/7" casing annulus. The top of the plug remains at 10 feet, as originally designed. The modified P&A plan shall be binding on the permittee.

PART II, Section F DEMONSTRATION OF FINANCIAL RESPONSIBILITY (Condition 1)

A Standby Trust Agreement has been established between Murphy Oil USA, Inc. and the United States Fidelity and Guaranty Company. As part of the Standby Trust Agreement, Murphy Oil submitted a Surety Performance Bond in the amount of \$25,000 to cover the plugging of EPU 8-D. The coverage was reviewed and determined to meet the financial criteria established by the EPA.

The actual injection pressure is expected to increase during the operational life of the well. An increase in friction loss or formation pressure build up may necessitate higher operating pressures, consequently, provisions have been included in the permit that allow the permittee to request an increase in the injection pressure.

## INJECTION VOLUME LIMITATION

(Condition 5)

Calculations were performed to verify that the proposed maximum injection pressure and rate are compatible. Equation (2) was used to check the compatibility of the proposed maximum injection pressure with the maximum allowable injection rate.

$$Q = (7.07kb[P_i - P_p])/m(\ln r_e/r_w) \quad (2)$$

Where,

- Q = maximum injection rate (BWPd)
- k = injection zone permeability (darcy)
- b = thickness of injection zone (feet)
- P<sub>i</sub> = injection pressure at sand face (psig)
- P<sub>p</sub> = injection zone pore pressure (psig)
- m = viscosity of water (centipoise)
- r<sub>e</sub> = distance of 1/4 mile exemption boundary (feet)
- r<sub>w</sub> = well bore radius (feet)

*φ = 31  
per 21nd*

Several assumptions were made to approximate the worst case situation and account for the inherent uncertainty in modelling the situation. First, the permeability of the injection formation, k, was determined from annual monitoring reports submitted by the permittee to be approximately 0.035 darcies. Next, the injection zone pore pressure, P<sub>p</sub>, was estimated to be equal to the hydrostatic head in the well. Finally, the viscosity of the injection fluid, m, was set equal to the viscosity of fresh water at 68 degrees F. The calculated injection rate, Q, was 7,083 BWPd. Pressure values are for the top of the injection intervals, 830 feet.

$$Q = \frac{(7.07(0.035)(50)(606 - 200))}{1.00[\ln(1,320/0.531)]}$$

$$Q = 310 \text{ BWPd}$$

at surface injection pressure = 200 psig

The maximum proposed injection rate of 8,400 BWPd is greater than the calculated theoretical injection rate. Therefore, the proposed maximum rate is not acceptable.

PART II, Section C

WELL OPERATION

INJECTION INTERVAL

(Condition 3)

The injection formation is the Judith River formation in the Williston Basin. The Judith River is a light gray, fine to medium grained, calcareous, glauconitic sandstone. It is approximately 200 feet thick and is located from 750 to 950 feet. The upper confining zone, the Bear Paw shale, is a gray shale approximately 500 feet thick. It is located from 250 to 750 feet. Information is not available on the fracture pressures of either formation.

*note 1*  
The water quality of the the Judith River formation prior to initial disposal of produced water was greater than 10,000 mg/l TDS. The average injection rate for the EPU 8-D was 6,250 bbl/day. The total fluid volume injected in eight (8) years is 766,500,000 barrels.

The permit limits the injection to the interval between 830 to 880 feet. The interval between 830 to 880 feet has 4 perforations per foot for a total of 200 perforations. A tracer survey analysis submitted by Gearhart Industries, Inc. states that a majority of the fluid movement is between 830 to 840 feet, and very little fluid movement between 840 to 860 feet. The remaining portion of the fluid is lost between 860 to 880 feet. Based upon this analysis, fluid movement has been restricted to the injection zone.

INJECTION PRESSURE LIMITATION

(Condition 4)

The Judith River formation is currently taking between , to , BWPd at an average surface injection pressure of 650 psig. The applicant requested an average injection pressure of psig and a maximum injection pressure of psig. The proposed maximum injection pressure is not approved.

The maximum surface injection pressure as established in 40 CFR 147.1353 is given in Equation (1).

$$P_m = (0.733 - 0.433S_g)d \quad (1)$$

Where:

- $P_m$  = injection pressure at the well head (psig)
- 0.433 = density of water (psi/ft)
- $S_g$  = specific gravity of injection fluid  
(value determined from TDS value (130,000 mg/l = 1.13))
- $d$  = height of fluid column or specific depth (feet)

The maximum surface injection pressure is:

$$P_m = (0.733 - 0.433(1.13)) 830$$
$$P_m = 202 \text{ psig}$$

Judith River 680'

Claggett 790'

Eagle 1,000'

Niobrara 2,005'

Carlisle 2,155'

Greenhorn 2,350'

Graneros 2,542'

Muddy Sandstone 2,900'

Skull Creek 2,946'

Kd?  
Judith River Siltstone 3,112'



Figure 1. Downhole Schematic and Geology for EPU 8-D.



PART II, Section A

WELL CONSTRUCTION

CASING AND CEMENTING

The EPU 8-D was constructed in 1955 as an oil producer and converted to a disposal well in 1978. The casing and cementing details were submitted with the permit application and are binding on the permittee. The plugging and abandonment (P&A) plan submitted with the permit application was modified to meet EPA requirements for plugging and abandonment. These changes are binding on the permittee. The downhole schematic and geology are represented in Figure 1. The details of the well construction and P&A plan are delineated in Table 1.

During original construction the 13 3/8" (H-40) conductor pipe was set at 100 feet with 200 sacks of cement and the 9 5/8" (H-40) surface casing was set at 960 feet with 400 sacks of cement. The 5 1/2" (J-55) production casing was set at 5,765 feet with sacks of cement. The 2 7/8" tubing (J-55) was set at 737 feet with a Model A-1 packer at 732 feet. The operator placed a cast iron bridge plug (CIBP) at 1,000 feet. The 5 1/2 casing was perforated from 990 to 991 feet, a cement retainer was set at 960 and cement squeezed in the annulus between the 9 5/8" and the 5 1/2" casings to surface. *dur the 1978 conversion*

The permittee did not supply any evidence to demonstrate the quality of cement bonding between the casing and well bore. Class "G" cement will be used in the plugging and abandonment of the well. *sa pack set at 660 feet squeezed 100 sacks*

A potential underground source of drinking water (USDW) in this area is a shallow tertiary sand. The Judith River and Eagle formations do not qualify as USDW's because the TDS for either formation is greater than 10,000 mg/l. See the 1985 EPA policy report "Underground Injection Activities into the Judith River Formation on the Fort Peck Reservation" for more information on water quality in the Fort Peck area. Information provided by the permittee indicates the shallow tertiary sand is located in the subsurface interval from 100 to 250 feet and is the lowest most USDW identified by the permittee. In EPU 8-D, the 9 5/8" casing is cemented to surface and effectively seals the tertiary sand from potential migration of fluids (see Figure 1 for specific depths).

PART II, Section B

CORRECTIVE ACTION

CORRECTIVE ACTION

There are no wells in the area of review, therefore, corrective action is not necessary.

*note 1*  
*in the East Paper filed*  
were published in December, 1985, in an EPA policy report "Underground Injection Activities into the Judith River Formation on the Fort Peck Reservation". The Judith River formation has a total dissolved solids (TDS) concentration greater than 10,000 mg/l and as such does not qualify as an underground source of drinking water (USDW). At that time the well was authorized to resume injection as a rule authorized well.

All eligible injection wells in operation prior to the effective date of the UIC program in Montana (June 25, 1984) were automatically granted aquifer exemptions extending a one-quarter (1/4) mile radius from the well bore. Consequently, the EPU 8-D disposal well was granted a 1/4 mile radius aquifer exemption for the Judith River formation. The injection volume and fluid plume over the past eight years has exceeded the radius of aquifer exemption. However, the findings in the Judith River report determined that the quality of the formation water prior to injection was greater than 10,000 mg/l TDS. Therefore, an aquifer exemption and/or extension of the exemption are not necessary.

*as of MTS21*  
An average injection rate of 7,100 barrels of water per day (BWPD) at a surface pressure of 650 psi will be disposed into the Judith River formation via the EPU 8-D well. The operator requested a maximum injection rate of 8,400 BWPD at a maximum surface pressure of 700 psi.

There are no known drinking water wells that penetrate the injection zone in the area of review and no wells within the area of review.

A casing/tubing annulus pressure test was performed and witnessed by a representative of the EPA on September 27, 1985. The EPU 8-D disposal well passed the test, demonstrating the absence of leaks in the casing, tubing or packer.

Murphy Oil has submitted all required information and data necessary for permit issuance in accordance with 40 CFR Parts 144, 146 and 147 and a draft permit has been prepared.

The permit will be issued for the operating life of the injection well. Therefore, no reapplication will be necessary unless the permit is terminated for reasonable cause (40 CFR 144.39, 144.40 and 144.41). However, the permit will be reviewed every five years (See 144.36.).

This Statement of Basis gives the derivation of EPU 8-D's specific permit conditions and reasons for them. The general permit conditions for which the content is mandatory and not subject to site specific differences (based on 40 CFR Parts 144, 146, and 147), are not included in the following discussion.

Calculations were performed to determine the maximum allowable surface injection pressure and compatibility of maximum injection pressure and rate in the Judith River formation. The calculations indicated the maximum requested injection injection pressure and rate are acceptable.

*not*  
All depths in this Statement of Basis are measured from below ground surface.

## STATEMENT OF BASIS

Date Prepared\* November 17, 1986

MURPHY OIL  
POPLAR EAST UNIT, ROOSEVELT COUNTY, MONTANA  
UIC PERMIT NUMBER\* MTS21PR-0023

### CONTACTS\*

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Region VIII  
Ground Water Section  
th  
999 18 Street, Suite 500  
Denver, Colorado 80202-2405  
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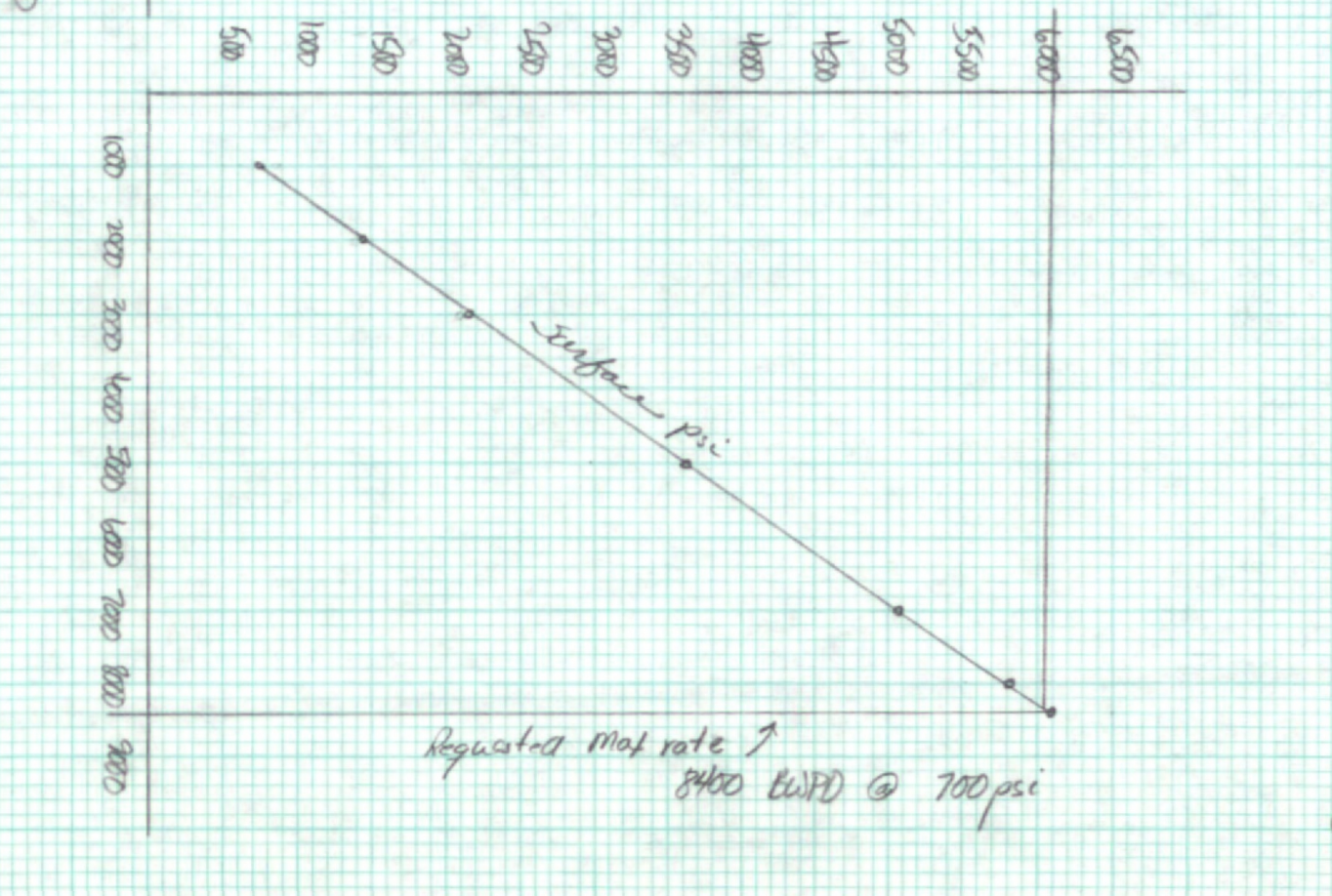
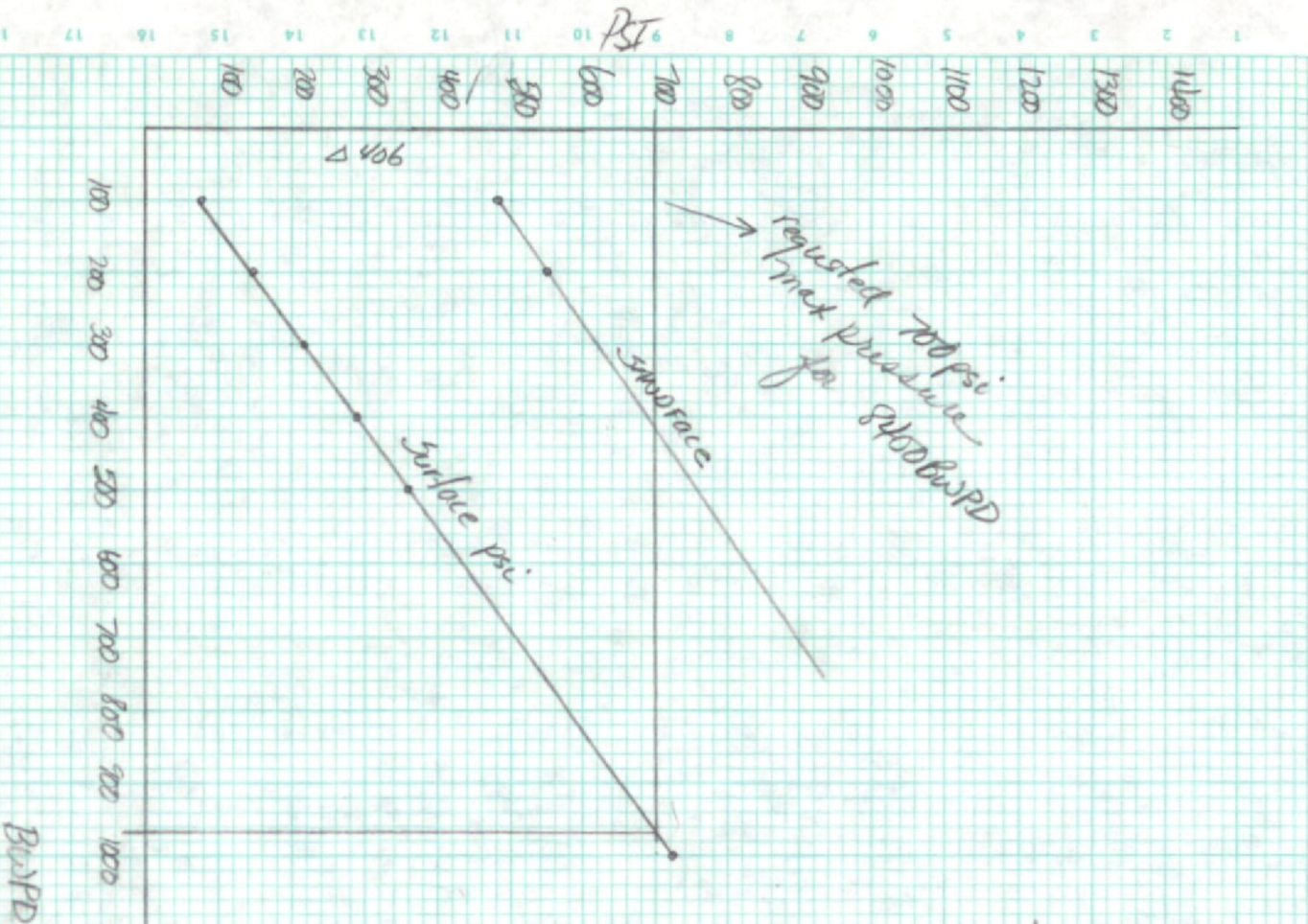
U.S. Environmental Protection Agency  
Montana Office  
Federal Building, Drawer 10096  
301 South Park  
Helena, Montana 59626  
Telephone\* (406) 449-5414

### Description of Facility and Background Information:

In accordance with 40 CFR 144.25 (b), Murphy Oil was notified that a permit application was required for the East Poplar Unit 8-D salt water disposal well. EPA received the permit application August 29, 1984. The EPU 8-D well is located 1,980 feet from the South line and 1,980 feet from the East line of Section 10, Township 28 North, Range 51 East in Roosevelt County, Montana.

The EPU 8-D well has been injecting produced fluids from the Mississippian Madison "A", "B", and "C" formations in the East Poplar Field into the Judith River formation since 1978. The well was temporarily abandoned in April, 1985 until after the findings from the May 29, 1985 Judith River Public Hearing. The Public Hearing was convinced at the request of the Fort Peck Tribes. The Tribes requested the hearing in order to present information necessary to designate the Judith River formation as an underground source of drinking water (USDW) under 40 CFR 146.4(c). The findings from the hearing







Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Rate from Known Injection Pressure

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy) = 0.031 darcy's /  
Height of Inj. Zone (ft) = 50 ft  
Viscosity of Inj Fluid = 1 centipose  
Area Review (ft) = 1320 ft  
Well Bore Radius (ft) = 0.45833 ft

Hydrostatic Head = 830 ft  
Specific Gravity = 1.13  
Init Pressure @ Sandface = 406 psi  
Inj Pressure @ Surface = 650 psi  
Friction Loss in system = 0 psi

Hydrostatic Head = 406.1107 psi  
Delta P = 650.1107 psi  
Sandface = 1056.110 psi  
Inj. Rate = 894.3808 BWPD

*requested ave rate*

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Rate from Known Injection Pressure

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy) = 0.031 darcy's  
Height of Inj. Zone (ft) = 50 ft  
Viscosity of Inj Fluid = 1 centipose  
Area Review (ft) = 1320 ft  
Well Bore Radius (ft) = 0.45833 ft

Hydrostatic Head = 830 ft  
Specific Gravity = 1.13  
Init Pressure @ Sandface = 406 psi  
Inj Pressure @ Surface = 700 psi  
Friction Loss in system = 0 psi

Hydrostatic Head = 406.1107 psi  
Delta P = 700.1107 psi  
Sandface = 1106.110 psi  
Inj. Rate = 963.1676 BWPD

*requested max rate.*

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate =		200 BWP	Hydrostatic
Depth to injection zone =		830 ft	Head = 406.1107 psi
Specific gravity =		1.13	
Reservoir Pressure =		406 psi	Delta P = 145.3767 psi
			Sandface = 551.3767 psi
Friction loss in system =		0 psi	Surface psi = 145.2660 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate =		100 BWP	Hydrostatic
Depth to injection zone =		830 ft	Head = 406.1107 psi
Specific gravity =		1.13	
Reservoir Pressure =		406 psi	Delta P = 72.68835 psi
			Sandface = 478.6883 psi
Friction loss in system =		0 psi	Surface psi = 72.57765 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate	=	400 BWP	Hydrostatic
Depth to injection zone	=	830 ft	Head = 406.1107 psi
Specific gravity	=	1.13	
Reservoir Pressure	=	406 psi	Delta P = 290.7534 psi
			Sandface = 696.7534 psi
Friction loss in system	=	0 psi	Surface psi = 290.6427 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate	=	300 BWP	Hydrostatic
Depth to injection zone	=	830 ft	Head = 406.1107 psi
Specific gravity	=	1.13	
Reservoir Pressure	=	406 psi	Delta P = 218.0650 psi
			Sandface = 624.0650 psi
Friction loss in system	=	0 psi	Surface psi = 217.9543 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate	=	1000 BWPD	Hydrostatic
Depth to injection zone	=	830 ft	Head = 406.1107 psi
Specific gravity	=	1.13	
Reservoir Pressure	=	406 psi	Delta P = 726.8835 psi
			Sandface = 1132.883 psi
Friction loss in system	=	0 psi	Surface psi = 726.7728 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate	=	500 BWPD	Hydrostatic
Depth to injection zone	=	830 ft	Head = 406.1107 psi
Specific gravity	=	1.13	
Reservoir Pressure	=	406 psi	Delta P = 363.4417 psi
			Sandface = 769.4417 psi
Friction loss in system	=	0 psi	Surface psi = 363.3310 psi



Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate	=	3000 BWPD	Hydrostatic
Depth to injection zone	=	830 ft	Head = 406.1107 psi
Specific gravity	=	1.13	
Reservoir Pressure	=	406 psi	Delta P = 2180.650 psi
			Sandface = 2586.650 psi
Friction loss in system	=	0 psi	Surface psi = 2180.539 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate	=	2000 BWPD	Hydrostatic
Depth to injection zone	=	830 ft	Head = 406.1107 psi
Specific gravity	=	1.13	
Reservoir Pressure	=	406 psi	Delta P = 1453.767 psi
			Sandface = 1859.767 psi
Friction loss in system	=	0 psi	Surface psi = 1453.656 psi



Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate =		7000 BWPD	Hydrostatic
Depth to injection zone =		830 ft	Head = 406.1107 psi
Specific gravity =		1.13	
Reservoir Pressure =		406 psi	Delta P = 5088.184 psi
			Sandface = 5494.184 psi
Friction loss in system =		0 psi	Surface psi = 5088.073 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy)	=	0.031 darcy's	
Height of Inj. Zone (ft)	=	50 ft	
Viscosity of Inj Fluid	=	1 centipose	Data is calculated for this column
Area Review (ft)	=	1320 ft	
Well Bore Radius (ft)	=	0.45833 ft	
Injection Rate =		5000 BWPD	Hydrostatic
Depth to injection zone =		830 ft	Head = 406.1107 psi
Specific gravity =		1.13	
Reservoir Pressure =		406 psi	Delta P = 3634.417 psi
			Sandface = 4040.417 psi
Friction loss in system =		0 psi	Surface psi = 3634.306 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy) = 0.031 darcy's  
Height of Inj. Zone (ft) = 50 ft  
Viscosity of Inj Fluid = 1 centipose  
Area Review (ft) = 1320 ft  
Well Bore Radius (ft) = 0.45833 ft  
Injection Rate = 8400 BWPD  
Depth to injection zone = 830 ft  
Specific gravity = 1.13  
Reservoir Pressure = 406 psi  
Friction loss in system = 0 psi

*requested rate, at 700psi*

Data is calculated for this column

Hydrostatic Head = 406.1107 psi  
Delta P = 6105.821 psi  
Sandface = 6511.821 psi  
Surface psi = 6105.710 psi

Compatibility of Maximum Proposed Injection Rate and Pressure  
Calculation of Pressure from Known Injection Rate

Well Name: EPU 8-D  
Operator: MURPHY OIL CO.

Well Number: MTS-0023  
Auth Number: MTS21PR-0023

Permeability (darcy) = 0.031 darcy's  
Height of Inj. Zone (ft) = 50 ft  
Viscosity of Inj Fluid = 1 centipose  
Area Review (ft) = 1320 ft  
Well Bore Radius (ft) = 0.45833 ft  
Injection Rate = 8000 BWPD  
Depth to injection zone = 830 ft  
Specific gravity = 1.13  
Reservoir Pressure = 406 psi  
Friction loss in system = 0 psi

Data is calculated for this column

Hydrostatic Head = 406.1107 psi  
Delta P = 5815.068 psi  
Sandface = 6221.068 psi  
Surface psi = 5814.957 psi



17 June 85

Info supplied to Lema for  
Haj

Status of EPU 5-D - Currently being  
used as a SWD well.

Well - EPU 8-D UICID: MTS 21PE-0023  
Operator - Murphy Oil USA, Inc  
Location - C NW SE 10 - T28N - R51E

INS. Formation: Judith River  
Interval : 830-880

Status - Well has been temporarily abandoned -  
injection has ceased - until aquifer  
exemption decision for Judith  
River. Hearing held 29 May.  
Currently awaiting decision on the  
information gained from that hearing.

- Geahart -

- EPU 8-0 -

3(A) What was being requested is  
that you insert "R to U"

R = Surety bond.

S = Aquifer exemption

T = Existing E&M Permits

U = Description of Surveys.

- Need an interpretation of Geahart's  
R.T. log. However the  
log sets



REF: 8WM-DW

Mr. Alvin W. Simpson  
Manager of Operations  
Murphy Oil, U.S.A., Inc.  
200 Peach Street  
El Dorado, Arkansas 71730

RE: Underground Injection Control (UIC)  
Permit Application for East Popular  
Field, Montana Wells EPU 1-D, 5-D  
8-D, 29-D, 59-D and 80-D

Dear Mr. Simpson:

Your December 5, 1984 letter, responding to EPA's request for additional information to complete the UIC applications for the above referenced wells, was received on December 7, 1984. Since that time the permit writers have been awaiting the names and addresses of the people to whom area of notification was sent and the authorization from your Vice President duly appointing you as Murphy Oils representative. Sufficient time has elapsed for you to accomplish this. Accordingly, the permit writers have made a review of the information submitted and have listed deficiencies still remaining in your applications. They are attached as Attachments 1 and 2. For specific questions you have pertaining to individual wells, call the appropriate permit writer.

The time granted by EPA for Murphy Oil to complete the injection well applications has been sufficiently long for you to obtain the necessary information. An extension for the original application was granted from July 30, 1984, deadline until August 30, 1984. The deficiency letter mailed on October 30, 1984, requested missing information by November 26, 1984. An extension was granted until December 10, 1984, in order for Murphy Oil to provide the necessary information. The information sent on December 5 had two outstanding deficiencies, indicated by you as area of notification information and authorization for you to become the duly authorized representative for Murphy Oil. Many deficiencies listed in the attachments were indicated in the October 30, 1984 letter and need to be addressed.

Murphy Oil now has fourteen days from receipt of this letter to submit all requested information. There will be no further extensions. If at the end of the fourteen days the necessary information has not been received, the authorization by rule for the above wells automatically terminates, and Murphy Oil is required to shut-in the wells. If the wells are not shut-in, then the maximum civil penalty or criminal fine of up to \$10,000 per day shall be assessable for each instance of violation.



If you need clarification of the information requested in the Attachments, call Michael Liuzzi at (303) 293-1414 for wells EPU 1-D, 5-D, and 8-D; and call Angus Campbell at (303) 293-1420 for wells EPU 29-D, 59-D and 80-D.

Sincerely,

Max H. Dodson, Director  
Water Management Division

LIUZZI/craig/02/05/85/0904P/page 1/draft  
editing/02/06/85/campbell  
editing/corrections/1st final print 02/06/85/craig



Attachment I

COMMON DEFICIENCIES FOR ALL WELLS:

The common deficiencies for wells EPU 1-D, EPU 5-D, EPU 8-D, EPU 29-D, EPU 59-D and EPU 80-D are as follows:

- 1) Written notification from Vice President or higher appointing Alvin W. Simpson as duly authorized representative.
- 2) Submittal of the names and addresses to whom the area of notification was sent.
- 3) Submittal of a 1:24,000 topography map which depicts surface water and location of the well (See Attachment A).
- 4) Need the fracture pressure for the upper confining and lower confining zones. Information used throughout the field for these particular formations is acceptable for existing wells. (See Attachment G).
- 5) Need a determination of the water quality (parts per million of TDS) for the unknown Territory Sand indicated in Attachment E.
- 6) Identify fluid used as corrosion inhibitor. (See Attachment H).
- 7) Submit the Cement Bond Logs for each of the above wells.
- 8) Submit Attachment T information. (See October 30th letter).
- 9) The estimated plugging and abandonment costs seem insufficient, as compared to other permits for similar types of wells. This estimated cost is the cost of plugging the well if EPA has to do the job. These costs include contracting all work out.
- 10) Financial Status Report - EPA is requiring a financial instrument of a letter of credit.



ATTACHMENT II

SPECIFIC DEFICIENCIES FOR WELLS: EPU 1-D, 5-D, 8-D  
Permit Writer: Michael Liuzzi 303-293-1414

The specific deficiencies for each well are listed below under the heading identifying each well.

1) EPU 1-D

- A. What is the depth to the Judith River formation? In addition, there appears to be another water bearing formation indicated on well logs on file at EPA. The formation is at an approximate depth of 1100 feet. What is the name of the formation and what is water quality in this formation?
- B. Clarify the discrepancy between the indicated average injection volume and the result of multiplying the average injection rate and the average hours of operation. See Attachment H.
- C. The information requested on page 3 of the October 30th letter to you has not been completed. Put the requested information on the schematic you sent for EPU #78. There is an inconsistency between the initial submittal and the December submittal relating to the status of EPU #78. The August Submittal indicated that EPU #78 was "plugged and abandoned". The December submittal indicates that EPU #78 is "Temporarily Abandoned." Which is correct? If EPU #78 is temporarily abandoned, how is the well being maintained during the period of temporary abandonment?
- D. Note discrepancy on the plugging and abandonment form. The depth indicated for the 5 1/2" casing is 3084 feet. Placing the cast iron bridge plug at 3100 feet does not have the cement or plug in the 5 1/2" casing but in the 7" casing. The calculated top of plug is in error and needs to be corrected. A minimum of 50 feet of cement is recommended for plugs, therefore, additional cement is required. Also, the information requested for plug #2's location is still needed. (See Attachment Q).
- E. Refer to the Brine Disposal Form 520-10 and respond to the question in the October 30th letter on page 4 for EPU 1-D. Why is the hole depth for 165 feet of casing given as 375 feet? In like fashion provide a similar explanation for the remaining casing sizes of 9 5/8", 7" and 5".